MULTI-LAYER MICROFLUIDIC DEVICES FOR AMINO ACID BIOMARKER ANALYSIS: THE MARS ORGANIC ANALYZER

Alison M. Skelley, James R. Scherer, Andrew Aubrey[1], Pascale Ehrenfreund[2], Jeffrey L. Bada[1], Frank J. Grunthaner[3] and Richard A. Mathies

Department of Chemistry, University of California, Berkeley, CA, 94720, USA;
[1]Scripps Institution of Oceanography, University of California at San Diego, La Jolla, CA, 92093, USA;
[2]Leiden Observatory, Leiden University, 2300 RA Leiden, the Netherlands; [3] Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA, 91109, USA

Sensitive amino acid composition and chirality analysis has been achieved using the Mars Organic Analyzer (MOA), a portable microfabricated capillary electrophoresis (CE) instrument [1]. The microdevice consists of a four-layer sandwich structure combining glass CE separation channels, microfabricated pneumatic membrane valves and pumps, and a nanoliter fluidic network [2]. The portable MOA instrument integrates all high voltage CE power supplies, pneumatic controls, and fluorescence detection optics needed for field operation. Depending on the injection method, the concentration sensitivities range from μM to 0.1 nM for amino acids, corresponding to part-per-trillion sensitivity [3]. The MOA has been used to analyze soil extracts from the Atacama Desert; an increasing level of amino acids up to 50 ppb is detected in the north-south transect corresponding to increased precipitation levels. Field tests in the Panoche Valley CA successfully detected amino acids at the 5-to-100 ppb levels in jarosite, a key sulfate-rich mineral associated with liquid water recently detected on Mars. These results demonstrate the use of the MOA to perform high sensitivity in situ amino acid biomarker analyses in the field on samples relevant for Mars exploration. See http://astrobiology.berkeley.edu.

References

[1] A. M. Skelley, J. R. Scherer, A. Aubrey, R. H. C. Ivester, P. Ehrenfreund, F. J. Grunthaner, J. F. Bada and R. A. Mathies, *Proc. Natl. Acad. Sci. U.S.A., submitted* (2004).

[2] W. H. Grover, A. M. Skelley, C. N. Liu, E. T. Lagally and R. A. Mathies, *Sens. Actuators B,* **89**, 325 (2003).

[3] A. M. Skelley and R. A. Mathies, *J. Chromatogr. A,* **1021** (1-2), 191-199 (2003)..

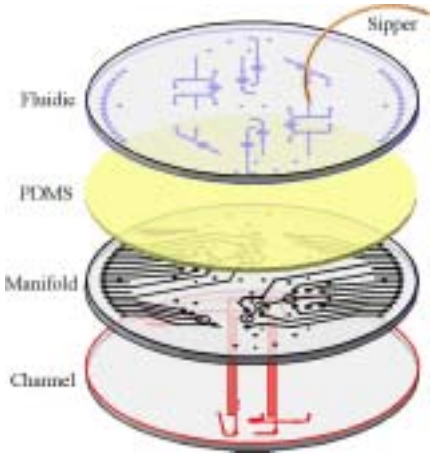

Figure 1. Microfabricated wafer for sample preparation and amino acid analysis. The 100-mm diameter microfabricated wafer stack is composed of a 4-layer sandwich of glass and PDMS to create channels and pumping structures.

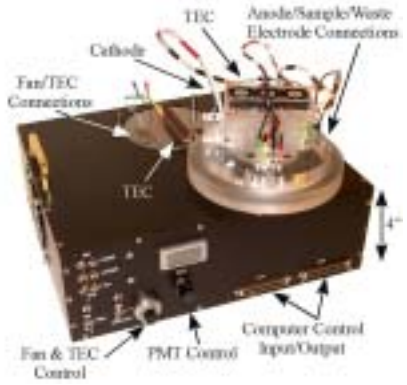

Figure 2. The Mars Organic Analyzer (MOA). The portable CE instrument, measuring 4" x 10" x 12", integrates all necessary pneumatic actuation, high voltage power supplies and confocal optics for laser excitation and fluorescence detection.